

Script for the talk

DM@Collider summary plots for snowmass - plans for DM simplified models

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In this short contribution, I will talk about our plans and briefly introduce the methods that we intend to use, the inputs that would be required by the various future collider experiments, and the summary plots that can be made for dark matter at colliders. On slide two, the figure on the bottom right shows an example of European Strategy summary plot on indirect detection plane where the future collider inputs show on the top figure. These are plots that compare results of dark matter searches at collider, direct and indirect detection and have been prepared for the European Strategy. These plots use as comparison benchmarks the simplified models in the Dark Matter Forum whitepaper [arxiv: 1507.00966], but they are only made for coupling values of order unity [arxiv: 1703.05703]. For Snowmass, we propose to prepare a similar set of plots where the coupling is varied to reach lower values. This will allow us to have a more complete picture of the complementarity of collider DM searches with direct and indirect detection, as well as compare collider results with collaborations that are sensitive to much lower couplings, such as accelerator-based and fixed target experiments. We will need to agree on benchmark models and representation of results with all other experiments before collecting inputs.

Now we propose four types of summary plots that may go into snowmass procedure. First, on slide three, there are exclusion contours on DM mass - mediator mass plane. We only show limiting cases in terms of couplings here. The shaded area on the contour are excluded at 95% CL. This kind of summary plots are best to combine all different searches for DM@Collider and show exclusion in the parameter space of DM simplified models. But to show constraints on the visible decay of mediator more intuitively, it's better to show limits on coupling - mediator plane as on slide four where we show an example of 95% CL upper limits for Axial-vector mediator coupling to standard model (SM).

On slide five, the exclusions on collider plane are translated via equations [1] and [2] for Axial-vector mediator and scalar mediator. The Direct Detection (DD) comparison with translated results for Scalar mediator limit at collider shows on the right. Note the DD collaboration shows their limit at 90% CL. The constrained

variable here is DM - nucleon cross section as DM scattering with nucleon is Spin Independent (SI) for Scalar mediator. On slide six, we show an example of how exclusions of collider limits are translated via equations below. The translation procedure are same for European Strategy summary plot in Indirect Detection (ID) plane. Note the ID collaboration shows their limit in terms of Majorana DM so that we need to convert their limit by a factor of two to convert the limit to Dirac DM.

The list of analyses we propose to put on these plots are mono-jet, mono-photon, mono-top, di-jet and di-lepton analyses. And we may include HL-LHC as future collider input. Other future collider options (including muon colliders) can be discussed jointly between energy and accelerator frontier meeting. Our work can start from DM simplified model results at given coupling and mass. With an analytical interpretation, we can make plots for other couplings as well. After agreeing on models, we will collect inputs for specific model from other collaborations and validate the Madgraph UFO and settings. We would like to write a letter of intend (LOI) or whitepaper for snowmass with these plots.

Thank you!